MST210 Guide

Introduction

Welcome to MST210 *Mathematical methods, models and modelling*. This 60-credit module is the core Level 2 applied mathematics module of several mathematics and mathematics-related degrees. The module is designed to teach the 'pencil and paper' techniques that are at the core of applied mathematics. These techniques are introduced alongside their major applications, which is desirable because these two aspects of the module complement and reinforce each other. These core topics are an essential prerequisite for study of Level 3 modules in both applied mathematics and physics.

The assumed mathematical starting point is successful completion of both MST124 and MST125. However, we realise that some students will have studied MST121 and MS221 instead, so we have designed Bridging Material to help to fill the gap between MST121/MS221 and MST210.

Mathematics is both enjoyable and creative in its own right, but it is also a powerful tool in the solution of real problems. The MST210 modelling activity aims to equip you to tackle real-life problems using your mathematical knowledge, by introducing you to the process of mathematical modelling. The modelling activity takes place in dedicated study weeks in the second half of the module. A significant part of the modelling activity is the writing of a brief report on a mathematical model that forms part of TMA 07. The modelling activity also includes tasks to be completed in small groups, and your participation within the group will be required. The assessment of this group work activity also forms part of TMA 07.

Getting started and use of technology

The background knowledge that is assumed corresponds to successful completion of MST124 and MST125.

This means that you are expected to be familiar with standard mathematical notation and elementary functions (such as sines, cosines, logarithms and exponentials). We also assume that you are familiar with algebra, calculus and complex numbers, and

have had an introduction to Newtonian mechanics. The module starts with an online diagnostic quiz, which will indicate to you the areas of the assumed background knowledge that you might need to study more carefully. You are also expected to be familiar with the Maxima computer algebra system that was introduced in MST124 and used in MST125. If you are not familiar with Maxima, then we suggest that you read the MST124 computer algebra guide that can be downloaded via the module website.

You will need access to a computer in order to download assignments and access the Study planner that describes the activities that you should be doing each week. There will also be supplementary teaching materials (such as screencasts, videos and practice quizzes) made available online. You will find details of these supplementary materials via links in the Study planner on the module website.

In addition to the above, a computer is needed to study the Maxima computer algebra sessions that are embedded in the module Study planner. These sessions show how a computer can be used to perform mathematical calculations. You may also need to use a computer (or a scientific calculator) to perform some calculations in continuous assessment questions, because some questions may ask for numerical answers. This particularly applies to the modelling activity. A computer or calculator will not be required in the exam, and you will not be allowed to take a computer or calculator into the exam.

You are welcome to use a computer algebra program (outside the final exam) to check your work, or to give you hints. But you will receive full credit in your tutor-marked assignments (TMAs) only if you show sufficient working to demonstrate that you understand the methods.

You will have the option to submit the TMAs electronically. The process for producing eTMAs on mathematics modules is different to what you may have been used to on other modules, so you will need to read the instructions on the module website carefully before submitting your work.

The module components

The module consists of a set of study texts, a handbook, a website and various other elements as described in the following pages.

Study texts

The module is based on printed text, supplied as six books, including numerous colour illustrations. The text is enhanced by the use of colour backgrounds for text to indicate important results (green background), historical notes (beige background) and study notes (white with green border). The themes of the six books are as follows.

- Book A revises and extends topics that you will have seen before in MST124 and MST125. The topics covered are differential equations, vectors, statics and dynamics. All of these are core topics that are essential for further study in MST210.
- Book B introduces some core mathematical methods involving linear equations. The book starts by discussing how matrices can represent linear equations, then looks at topics in the theory of matrices (determinants, eigenvalues and eigenvectors). This work is then applied to solve systems of linear equations and classify the stationary points of surfaces. The techniques introduced in this book are used extensively in Level 3 topics such as optimisation, as well as later topics in MST210.
- Book C starts by introducing the mathematical modelling strand of the module, which will be used in the modelling activity. The rest of the book is devoted to topics in mechanics, which is used to model a variety of real-world situations.
- Book D is a mathematical methods book that looks at some more advanced mathematical methods that are key prerequisites of Level 3 applied mathematics and physics modules. The techniques developed here are core topics in some Level 3 modules, for example fluid dynamics and quantum mechanics.
- Book E is another mathematical methods book, looking at vector calculus. This is a core topic needed for some Level 3 modules, for example electromagnetism.
- Book F starts with the second unit on mathematical modelling, which concentrates on evaluating and revising a mathematical model, and on report writing. Shortly after studying this unit you will be asked to evaluate and revise the model that you have derived as part of the modelling activity. The remainder of this book is devoted to more advanced topics in mechanics that are core topics in some Level 3 modules. For example, the concept of angular momentum introduced here is generalised in quantum mechanics and used to provide a mathematical description of atoms.

Handbook

The Handbook should be your constant study companion. It summarises the key ideas, techniques and formulas in each unit. You can also annotate it with your own notes. You should use it throughout your studies, so you become familiar with its layout.

You are allowed to take your Handbook (the printed copy sent to you), with your added annotations, into the end-of-module exam.

There are restrictions on the sorts of annotations that are permitted on the copy of the Handbook that you take into the exam. You can write notes on the pages in pencil or pen, but you may not include additional pages, replace pages or add sticky notes or index tabs. These restrictions are formally set out in the *Examination Arrangements* booklet, which will be made available to you shortly before the exam.

It is a good idea to initially use pencil or sticky notes for your annotations, until you are confident about which annotations are the most useful. You must check that you have removed all sticky notes before the exam.

Although you can take the Handbook into the exam, you should still aim to learn as much of the module material as you can. You should find that you start to remember it as you practise the mathematics and look up items in the Handbook. Re-reading parts of the units will also help. The more you can remember, the easier and quicker you will find it to study the MST210 materials, do the assignment and exam questions, and study further modules with mathematical content.

Website

You can access the module website from your StudentHome web page. There you will find the Study planner, the TMAs, and the specimen exam paper and its solutions, which are available only through the module website. It is important that you check the website frequently, as Errata and News items will be posted there.

The module website will give you access to the forums, which you can use to communicate with other students and with the MST210 team.

The Study planner is your key to understanding what tasks to do in each week while studying MST210. It contains links to screencasts, videos, computer algebra sessions and other study material.

Computer algebra

MST210 uses the Maxima computer algebra system that was introduced in MST124 and used in MST125.

You are expected to be familiar with the Maxima computer algebra system. If you are not familiar with Maxima, then we suggest that you read the MST124 computer algebra guide that is available via the module website. The module website also contains a link to a Maxima software website for MST124, MST125 and MST210 that contains instructions on how to install and start Maxima.

Some MST210 topics include Maxima activities to enhance the teaching in the main texts. Links to these activities are given in the Study planner. The activities contain examples showing how Maxima can be used to solve problems. Code can be cut and pasted from the examples into Maxima.

Practice quizzes

Practice is a key part of learning mathematics. There are many ways that you can practise in MST210. At key points in the unit text you will see exercises (with answers at the back of the text), and you are advised to complete these as you study the text. These exercises will help you to complete the TMAs, where you will receive individual feedback from your tutor on your answers.

In addition to these opportunities for practice, there are also practice quizzes available on the module website. These consist of short questions usually requiring either a single numeric answer or selection of the correct option from a list. These questions are similar to the questions in Part 1 of the exam at the end of the module.

You can do each practice quiz as many times as you like. The questions will usually be different each time you restart a quiz, and different from the questions that other students are given. So if you want to discuss the details of a practice quiz question with your tutor, you will need to tell him or her the details of the question.

You can attempt each question up to three times. After each attempt, you will receive immediate computer-generated feedback on your answer, and a reference to the relevant part of the study materials. Your marks for the question decrease with each incorrect attempt. Your marks for a practice quiz do not count towards the your final result for MST210.

You need to be online while you are working on a practice quiz, but you do not have to complete it in a single session – you can leave it and return to it as many times as you like.

Screencasts

The Study planner on the module website contains links to video clips, called screencasts, that can be viewed online or downloaded for later study. Screencasts amplify ideas contained in the study text and frequently talk through the key examples in the text. The Study planner indicates whether these videos should be studied before or after the associated text.

Assessment

The assessment comprises 8 tutor-marked assignments (TMAs), and an exam. TMA 01 is short – one-quarter size – and is completed a few weeks after the module starts. The aim of this TMA is to provide early interaction between you and your tutor, so that they can offer you early support if necessary. TMA 02 is also short – three-quarters size – and together with TMA 01 provides a full-length assignment that tests Book A. As this early interaction with your tutor is highly desirable, TMAs 01 and 02 are non-substitutable.

TMAs 03–06 and TMA 08 assess Books B to F, respectively. These TMAs are equally weighted (with the same weight as TMA 01 and TMA 02 combined), so that each of the six books has equal assessment. One of these five TMAs is substitutable, under the rules described in the *Assessment Handbook*.

TMA 07 is the assessment of the modelling activity. This is where the group work that you do as part of this activity is assessed. This TMA is non-substitutable and constitutes 16% of the continuous assessment score for this module.

Your final grade for the module is based on your continuous assessment score, your exam score and your rank score (which for this module is the average of your continuous assessment score and your exam score).

The ability to communicate technical ideas is a key skill that is highly sought after by employers. In order to foster the development of this skill, 5% of the marks for each TMA (apart from the very short first TMA) are set aside to be awarded for effective communication and the overall style of your answers. This will be judged by your tutor and added as a mark for an extra question in each assignment; that is, if there are four questions in an assignment, then the style marks will be awarded in the space for

Question 5. In TMA 01 your tutor will comment on your communication and style, but no marks will be awarded.

Exam

There is a three-hour exam at the end of MST210 that is based on the material in Books A to F. You should familiarise yourself with the format of the exam well in advance.

A specimen exam paper will be added to the module website in due course, and you should work through this carefully before the exam. Sample solutions are also provided. You will be allowed to take into the exam the printed Handbook, which will be mailed to you prior to the exam and which you may annotate as described above. No other printed or electronic materials will be allowed.

Support for your studies

It is important to try to keep up to schedule. Each assignment cut-off date is usually very soon after the end of the last study week for the relevant book. We recommend that you try to finish the assignment questions relating to each unit as soon as you finish that unit. Otherwise, you will have a lot of work to do in a few days before the cut-off date.

Your tutor

Your tutor is there to help you to understand the ideas in MST210, and will provide comments and feedback on your written assignments to help you with your studying. You are advised to go through each marked assignment in detail, and to take note of the comments written by your tutor; they will help you to avoid similar errors in later TMAs and in the exam. Try to attend tutorials – either face-to-face or electronic – where you will have the opportunity to talk to your tutor directly and, just as important, to talk to other students.

Your fellow students

One of the best ways of learning is by talking about your work with fellow students. Unfortunately, in Level 2 modules you may see them only at the infrequent tutorials during the year. That leaves a lot of weeks when you could be on your own. A convenient way to keep in touch is to use the MST210 forums.

Other support

You are not expected to study alone. Support is available from your tutor, through face-to-face and electronic tutorials, and via the module website. If you experience difficulties that are not directly related to the content of MST210, you are welcome to contact your Learner Support Team (see your StudentHome page for details).